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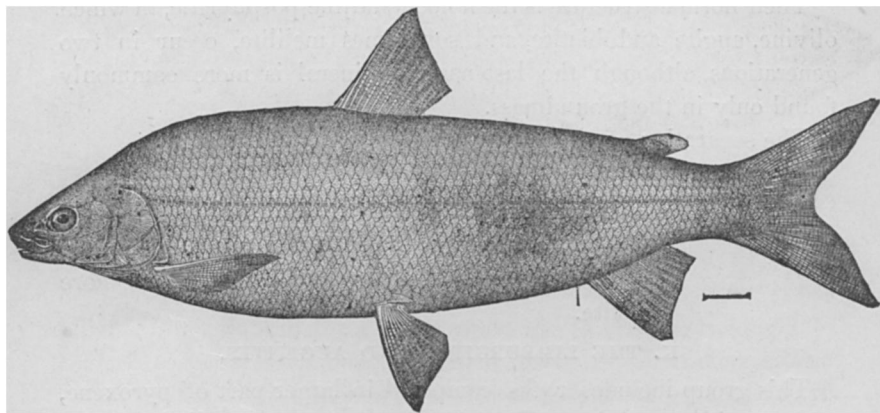
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DISTRIBUTION AND SOME CHARACTERS OF THE SALMONIDÆ.¹

BY TARLETON H. BEAN.

THE family of Salmonidæ—embracing the white fishes, the salmons, and the trouts—is one of the most important of the temperate and arctic regions of the world. For the purposes of this paper, I exclude all of Argentininæ, which have very little value, if we except the capelin, the eulachon, and the smelts. I omit, also, the graylings (*Thymallus*), which are set apart by Dr. Gill as representing a distinct family, *Thymallidæ*. The genera included in my essay are the following: *Coregonus*, *Stenodus*, *Oncorhynchus*, *Salmo*, and *Salvelinus*.

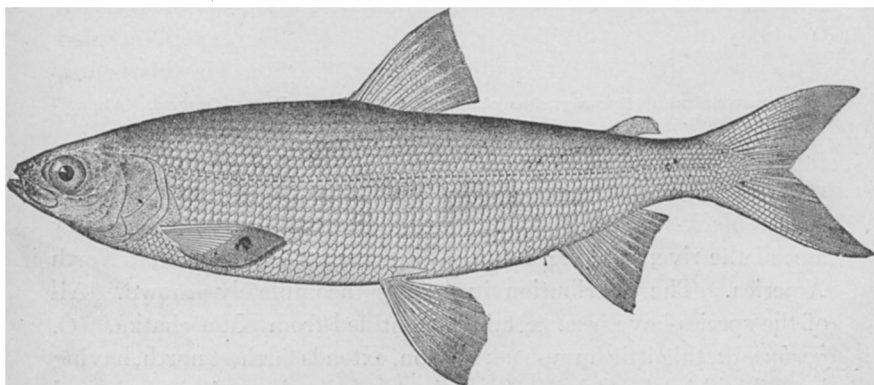


Common White-fish (*Coregonus clupeiformis*). Ecorse, Michigan. About $\frac{1}{4}$ natural length.

There are about forty nominal species of white fishes (*Coregonus*), of which twelve are North American, and are readily distinguished by good characters. Several species are found in Great Britain; the rest are distributed over the North of Europe and Asia, scarcely extending as far southward as 46° North latitude. The largest

¹Read before the Biological Society of Washington, Feb. 25, 1888.

species exist in Russia, Siberia, Alaska, and our great lakes. The relation between the Siberian and Alaskan forms has never been fully worked out; but species which have been considered identical from the two sides of Behring Strait proved upon examination to be distinct. The species of *Coregonus* are anadromous only in the far North. One species, which is not represented in America—*Coregonus oxyrhynchus*—leads an existence which is indifferently marine or fresh-water. In the United States, the most southerly species—and one of the smallest, *Coregonus williamsoni*—is found as far south as the Sevier River, in Utah, in about 38° North latitude, or eight degrees farther south than any species in the Old World. Three species extend as far north as Point Barrow—*laurettæ*, *nelsoni*, and *richardsoni*, the first and the last of these being valuable food species. *Coregonus pusillus* probably reaches Point Barrow also, as I have seen it in Hotham Inlet.

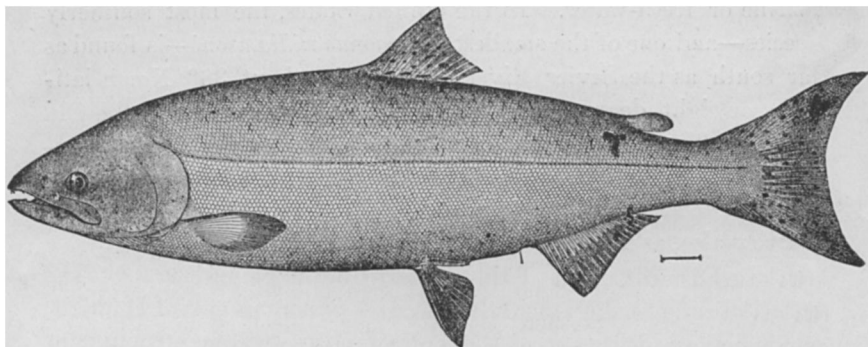


Vendace (*Coregonus albula*). Baland Lake, Prussia. About $\frac{3}{8}$ natural length. Introduced into the United States.

The most easterly of our white fishes are *labradoricus*, *quadrilateralis*, and *artedi*, all of which are small, and the last varies so much from the type to the eastward as to make its separation probable. The largest species are *clupeiformis* and *richardsoni*. *Clupeiformis* is the common white fish of the great lakes. It does not extend very far into British America, and is replaced northwestward in Alaska and the arctic portion of British America by the *Coregonus richardsoni* (*kennicotti* of late works).

Stenodus is believed to be nearly related to *Coregonus*; but its characters have not been fully studied. Its species reach a larger size than is usual in *Coregonus*. Only two are known with cer-

tainty, and these are closely similar. One of them is found in Alaska and the other in Russia. Other species are said to ascend some Siberian rivers from the Arctic Ocean. I have compared a specimen from the Volga with our Alaskan "inconnu," and find their similarity very striking. They agree substantially in number of fin-rays and rows of scales; but the first appears to have several more rows above the lateral line than the other.

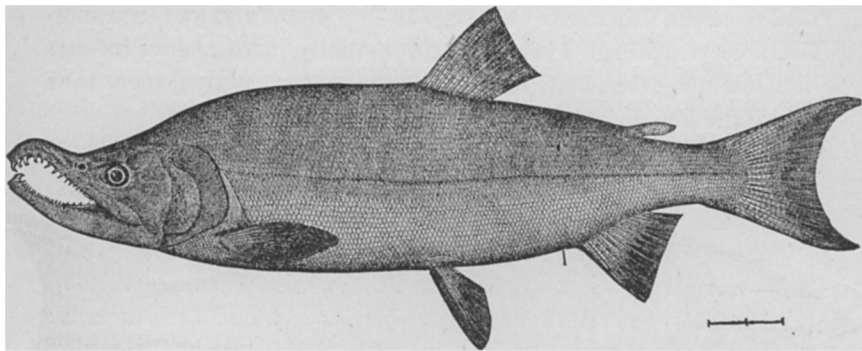


Quinnat Salmon (*Oncorhynchus chouicha*). Columbia River, Oregon. About $\frac{1}{2}$ natural length.

The genus of Pacific salmons (*Oncorhynchus*) which is very closely related to *Salmo*, is represented by five species, all of which are more or less black-spotted, especially while sojourning in streams. They ascend the rivers falling into the North Pacific in Asia and North America. The distribution in Asia is incompletely known. All of the species have been certainly identified from Kamschatka. *O. gorbuscha*, the little humpback salmon, extends farthest north, having been found in the Colville River in Alaska and ranging southward only to Oregon. The dog-salmon (*O. keta*) has been taken in the Kowak River, Alaska, and southward to California. The blue-back or red fish, *O. nerka*, extends northward at least to the Yukon and southward to the Columbia. Chouicha, the king or quinnat salmon, is known from the Ventura River, in California, to the Yukon, in Alaska. *O. kisutch*, the silver salmon, ranges from San Francisco, probably, to the Yukon. The most northerly species, *gorbuscha*, is the smallest and least valuable. The only good character which may be depended upon for distinguishing *Oncorhynchus* from *Salmo* is its numerous rays in the anal fin.

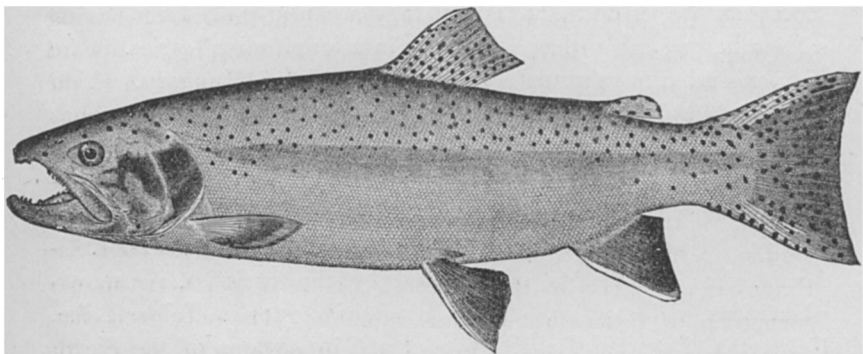
Salmo inhabits Great Britain and the Continent of Europe; it sends a representative into Africa; it is more or less represented in

Asia, and is well-established in North America. The Asiatic species are, for the most part, little known. Most of the species are non-migratory and inhabit fresh-water lakes and streams.



Blue-back Salmon (*Oncorhynchus nerka*). Wallowa Lake, Oregon. $\frac{1}{2}$ natural length. "Hook-jawed" male.

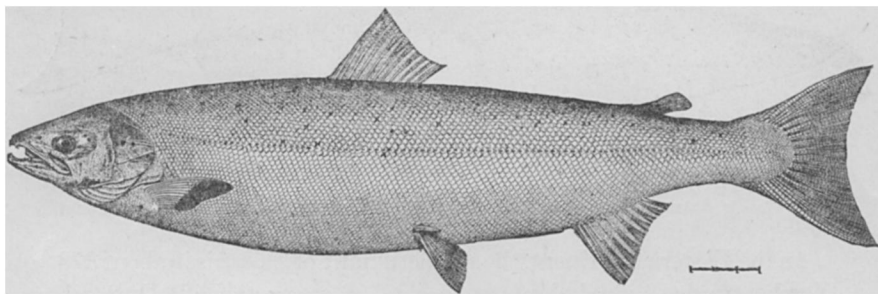
In the Eastern Continent, the southern limit of *Salmo* is in about 37° North latitude. A single doubtful species—*S. macrostigma* of Duméril, which may be identical with the common fario—was found abundant in the Oued-al-Abaïch, forty kilometres west of the town of Collo, in Northern Algeria. This species was founded on young specimens having about eight parr marks. The vomerines are figured as in two rows of about seven teeth each, just as in fario. The scales in British Museum examples are: 27, 122, 34; pyloric cæca, 28 to 31; vertebræ, 57. Their resemblance to young fario was observed by Dr. Günther.



Rainbow Trout (*Salmo irideus*). Verona, Missouri. About $\frac{1}{4}$ natural length. Introduced by U. S. Fish Commission.

In California one species, *Salmo irideus*, is found as far south as the Mexican line. But the most southerly of all our species and of

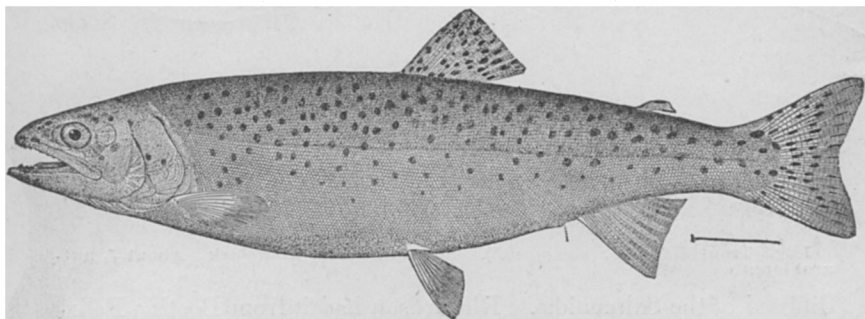
all the known Salmonoids of the world is mentioned by Professor E. D. Cope, in the *AMERICAN NATURALIST*, August, 1886, page 735. He has young black-spotted trout obtained by Professor Lupton from streams of the Sierra Madre, Mexico, at an elevation between eight and nine thousand feet, in the southern part of Chihuahua, near the boundaries of Durango and Cinaloa. They have teeth on the basihyals, and resemble, in other respects, *Salom purpuratus* of the Great Basin.



Atlantic Salmon (*Salmo salar*). Susquehanna River. About $\frac{1}{2}$ natural length. Introduced by U. S. Fish Commission.

Students of the Salmonidæ in Europe frequently refer all of the numerous nominal species of *Salmo* to three principal forms—*salar*, *trutta*, and *fario*. The first two represent the genus *Salmo*, characterized by anadromous habits and imperfect development of the vomerine teeth. The third is placed in the sub-genus *Fario*, which has persistent, well-developed vomerines in one or two series, and, in its habits is non-migratory. One noticeable feature about the European species of *Salmo* is that they are nearly all large-scaled seldom having more than 125 scales in a longitudinal series. The only exception to this rule is *Salmo microlepis* of Hungary, which has 135 to 140 rows of scales. North America and Asia have at least one species of *Salmo* in common,—a small-scaled species,—*S. purpuratus*. This is the most widely-distributed and the most variable of our species. Northward, we have no certain knowledge of it beyond Unalaska; southward, it ranges to Mount Shasta, in California. Its distribution is extended by the varieties, *henshawi*, *pleuriticus*, and *stomias*. *Salmo henshawi* occurs in Tahoe Lake, California, Pyramid Lake, Nevada, and in streams of the Sierra Nevada. *Salmo pleuriticus* occupies the Utah Basin and the headwaters of the Rio Grande. The trout found in Mexico may be closely similar to this, as it seems to inhabit affluents of the Rio

Grande. *Salmo stomias* dwells in the Upper Missouri and in the Kansas River. It is the most easterly of all our black-spotted trout. *Salmo purpuratus* has hyoid teeth, and, in all its varieties, bears a crimson blotch on the under surface of the head, which is characteristic of the species. It has, also, small scales, which diminish progressively in henshawi, pleuriticus, and stomias.



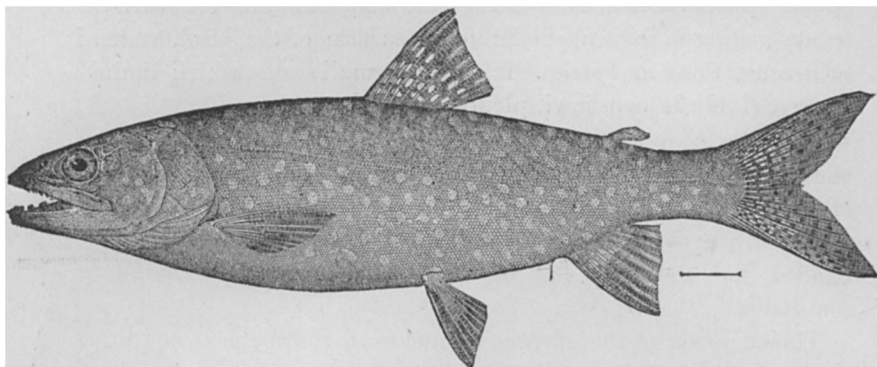
Clark's Trout (*Salmo purpuratus*). Sitka, Alaska. About $\frac{2}{3}$ natural length.

The eastern limit of our species of *Fario*, as already stated, is reached by the *Salmo stomias*. East of the Mississippi Valley no species of this genus are found native. The distribution of the species of *Fario* would seem to indicate that they originated in Asia or the Continent of Europe and migrated both to the eastward and the westward. In America the eastward distribution was checked by the plains of the middle region, which do not furnish conditions favorable to salmon-life; and the ocean barrier on the east prevented the spread of *Fario* into our Atlantic streams. If these black-spotted species were better adapted for Arctic life, their range might have been similar to that of the red-spotted charr.

Before leaving the black-spotted salmonoids, it may be well to add something concerning the singular Huchen or Rothfisch of the Danube. The genus *Hucho* has very small scales, pyloric cæca very numerous, gill-rakers short and few, vertebræ sixty-eight, a forked caudal, a remarkably broad maxilla, with a well-developed supplementary mental bone, a pike-like skull, and peculiar dentition; the jaw are armed with strong teeth; the vomerines and palatines are strong and in a continuous series—the palatine portion very long; tongue with teeth; hyoid toothless. The range of the single known species appears to be very restricted.

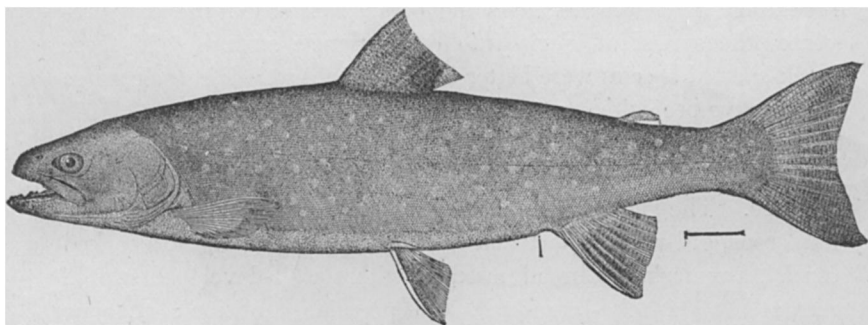
The genus *Cristivomer*, which appears to be only a section of *Sal-*

velinus, has two species, the lake-trout and the siscowet—namaycush and siscowet. The lake-trout is one of the largest and most widely



Lake Trout (*Salvelinus namaycush*). Raquette Lake, New York. About $\frac{2}{3}$ natural length.

diffused of the Salmonidæ. Richardson had it from Boothia Felix, in North latitude 70°. Turner found it very common in Labrador. It is very abundant in lakes of New England and New York and in the great lakes. We have obtained it recently from Henry Lake, in Idaho. This lake empties into Snake River, a tributary of the Columbia. We have also a head and fins of the species from Camin Lake, in British Columbia. Richardson records it from Great Bear Lake. Townsend and Stoney obtained specimens in the Kowak River, a stream flowing into Hotham Inlet, Alaska.

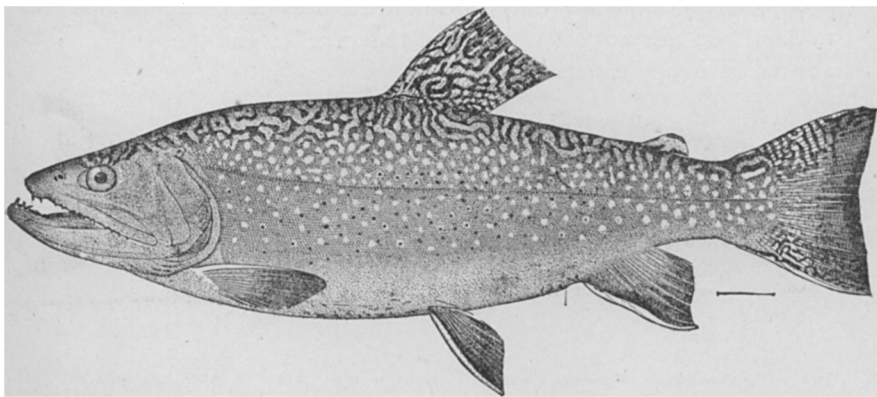


Dolly Varden Trout (*Salvelinus malma*). Cook's Inlet, Alaska. About $\frac{2}{3}$ natural length.

Eight species of *Salvelinus* are at present known in North America, only one of which, *malma*, we share with Asia. Seven of the species occur in eastern North America, and, with one or two exceptions, they are very closely related to the common saïbling of

Europe, *S. alpinus*. All of our species except *fontinalis*—the common brook trout—belong to the group having hyoid teeth. The largest species on both sides of our continent extend far to the northward: *malma* to the Colville River, in Alaska; *stagnalis* and *rossi* to Boothia Felix and Greenland. As a rule, all of our red-spotted charr with hyoid teeth have the dorsal and caudal fins without bands, while in the common brook trout—which is usually without hyoid teeth—these fins are always banded and mottled. The small charr of Monadnock Lake, in New Hampshire, *S. agassizi*, belongs to the group with hyoid teeth and forked tail. It has the dorsal and caudal banded, but the body has no mottlings, such as are found in *fontinalis*.

The character of the absence of hyoids in *fontinalis* is not to be absolutely depended upon in classification. About ten per cent. of the seventy-three examples obtained by Mr. L. M. Turner in Labrador have hyoids feebly developed, there being in no case more than three of these teeth present. From Castleton, New York, we have a specimen with hyoids; and in a brook trout from Woods Holl, Massachusetts, three hyoid teeth exist. It would seem that these, exceptional occurrences of hyoids are most pronounced and frequent in the northern portion of the habitat of *fontinalis*, the range of which species is now known to extend from Labrador to North Carolina, and, perhaps, Georgia.



Brook Trout (*Salvelinus fontinalis*). New York Market. $\frac{2}{3}$ natural length.

The most northerly species of *Salvelinus* recorded is the *arcturus* of Günther, a species which is said to lack red spots. If the current illustrations be correct, this is the least highly-ornamented of the

genus. No specimens longer than twelve inches are known, and these are mature. They were obtained in Victoria Lake, North latitude $82^{\circ} 34'$, and in fresh-water pools of Floeberg Beach ($82^{\circ} 28'$). This species is the most northern salmonoid known.

Before leaving this subject it may not be amiss to recall the fact that the origin of the Salmonidæ is obscure. No fossils of true Salmonidæ are known, except one genus, which is based upon the cranial bones only. This genus, *Rhabdofario* of Cope, is from Lake Idaho, a late tertiary lake in Eastern Oregon and Western and Southern Idaho. The following account of the *Rhabdofario lacustris* is from Professor Cope's paper in *Proceedings American Philosophical Society*, 1870:—

“A species with a head as large as that of the *Salmo salar*. The genus is nearly allied to *Salmo*. With no other portions of the animal than the cranial bones, the only difference I discover is in the form of the maxillary bones, which are sub-cylindric or rod-like, instead of flat or laminiform, as in *Salmo*. At the extremity, though flat, they are still narrow; and I do not find surface of attachment for the supernumerary bone of *Salmo*. Teeth on the maxillary and mandibular arches large, numerous; teeth on the vomer, glossohyal, and palatine bones also well developed. Muzzle and mandible subequal. Maxillary . . . bearing reduced teeth near its extremity.”

The pertinence of *Rhabdofario* to the Salmonidæ is, perhaps, open to doubt, on account of the shape of the maxilla and the probable absence of a supplemental bone.